XXVII. *On a new compound of Chlorine and Carbon.* By RICHARD PHILLIPS, *F. R. S. E. F. L. S. M. G. S. &c. and* MICHAEL FARADAY, *Chemical Assistant in the Royal Institution. Communicated by Sir* HUMPHRY DAVY, *Bart. P. R. S.*

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M. JULIN, of Abo, in Finland, is proprietor of a manufactory in which nitric acid is prepared, by distilling calcined sulphate of iron with crude nitre in iron retorts, and collecting the products in receivers connected by glass tubes, in the manner of WOULFE's apparatus. In this process he observed, that when a peculiar kind of calcined vitriol, obtained from the waters of the mine of Fahlun, and containing a small portion of pyrites, known in Sweden by the name of calcined aquafortis vitriol No. 3, was used, the first tube was lined with sulphur, and the second with fine white feathery crystals. These were in very small quantity, amounting only to a few grains from each distillation; but M. JULIN, by degrees, collected a portion of it, and, having brought it to this country, inserted a short account of its properties in the Annals of Philosophy, Vol. i. p. 216, to which a few observations were added by ourselves.

The following are the properties of this substance, as described by M. JULIN. It is white; consists of small soft adhesive fibres; sinks slowly in water; is insoluble in it whether

hot or cold; is tasteless; has a peculiar smell, somewhat resembling spermaceti; is not acted on by sulphuric, muriatic, or nitric acid, except that the latter by boiling on it gives traces of sulphuric acid; boiled with caustic potash, has a small portion of sulphur dissolved from it; dissolves in hot oil of turpentine, but most of it crystallizes in needles from the solution on cooling; dissolves in boiling alcohol of .816, but by far the greater part crystallizes on cooling; burns in the flame of a lamp with a greenish blue flame, giving a slight smell of chlorine gas; when heated, melting, boiling and subliming at a temperature between 350° and 400°, and subliming slowly without melting at a heat of about 250°, forming long needles. Potassium burned with a vivid flame in its vapour in an open tube, and carbon was deposited; a solution made of the residuum, and saturated with nitric acid, gave a copious precipitate with nitrate of silver. M. JULIN then remarks, that the small quantity he possessed, with want of leisure, prevented him from making any farther experiments on it; and concludes, by comparing it with the chlorides of carbon that have lately been formed.

The small quantity of the substance which, by the kindness of M. JULIN, we had at our disposal at that time, was insufficient to enable us satisfactorily to ascertain its nature. We found it mixed with free sulphur, and sulphate and muriate of ammonia. When purified, our first object, in consequence of M. JULIN's suggestion, was to compare it with the per-chloride of carbon, but it was found entirely distinct from it in its properties.

Since M. JULIN's return from the continent, he has very kindly placed some farther portions of this substance at our

disposal. We have therefore been enabled to continue our experiments, and have come to the very unexpected conclusion of its being another chloride of carbon, in addition to the two, an account of which has been published in the Transactions of the Royal Society for this year.

The substance, after being boiled in solution of potash, washed in water, dried and sublimed, formed beautiful acicular crystals, which appeared to Mr. W. PHILLIPS to be four-sided prisms. They contained no sulphur, and, when dissolved in alcohol or ether, gave no traces of chlorine or muriates, by nitrate of silver. They burned in the air with a strong bright flame at a heat below redness, and agreed with the description given by M. JULIN of the properties of the substance.

When heated moderately, it sublimed unaltered; but on passing a portion over rock crystal, heated to bright redness, in a green glass tube, it was decomposed, charcoal was deposited, and the gas, passed into solution of nitrate of silver, precipitated it, and proved to be chlorine.

A portion was repeatedly sublimed in a small retort filled with chlorine, which was made red hot in several places; it however underwent no change; but on cooling crystallized as at first. It was also exposed in the same gas to sun light for many days, but no change took place.

When raised in vapour over hot mercury, and detonated with excess of oxygen, a quantity of carbonic acid gas and chloride of mercury were produced. There was no change in the volume of gas used; and lime water being passed into it, absorbed the carbonic gas, became turbid, and left a residuum of pure oxygen. Acetic acid being then added, to dissolve the carbonate of lime, the solution was tested for

chlorine, which was readily found in it. When detonated with oxygen, the substance being in excess, there was expansion of volume, carbonic oxide, carbonic acid, and chloride of mercury being formed.

When phosphorus, iron, tin, &c. were heated to redness in its vapour over mercury, it was decomposed, chlorides of those substances being formed, and charcoal deposited; and M. JULIN has shown that the same effect is produced by potassium.

Three grains of this substance were passed in vapour over pure peroxide of copper, heated to redness in a green glass tube: a very small portion passed undecomposed. The gas received over mercury equalled 5.7 cubic inches; it was carbonic acid gas. A small part of the oxide of copper was reduced, and portions of a crystalline body appeared within the tube, which, on examination, proved to be chloride of copper. Some of this was used in making experiments on its nature; but when that was ascertained, the remaining contents of the tube were dissolved in nitric acid, and precipitated by nitrate of silver: 6.1 grains of chloride of silver were obtained.

Two grains were passed over pure quick lime, raised to a red heat in a green glass tube. The moment the vapour came in contact with the hot lime, ignition took place, and the earth burned as long as the vapour passed over it. When cold, the tube was examined, and much charcoal found deposited at the spot where the ignition occurred. The contents of the tube were dissolved in nitric acid, and the filtered solution precipitated by nitrate of silver: 5.9 grains of chloride of silver were obtained.

These results afford us sufficient data from which to deduce the nature and composition of this body. All the experiments of decomposition indicate it to contain chlorine and carbon, and those with oxygen and the metals, sufficiently prove the absence of hydrogen and oxygen. With regard to the proportions of the elements, three grains of the substance gave 5.7 cubic inches of carbonic acid gas, therefore two grains will give 3.8 cubic inches. One hundred cubic inches of carbonic acid gas weigh 46.47 grains, and contain 12.72 grains of carbon; and 3.8 cubic inches will therefore contain 0.483 grains of carbon. The two grains of the substance decomposed by heated lime gave 5.9 grains of chloride of silver, which, according to Dr. WOLLASTON's scale, equal 1.45 of chlorine; hence the two grains gave chlorine - - - 1.45

carbon - - - .483

1.933

The loss here is 0.067, which is by no means important, when the small quantity of the substance and the nature of the experiments are considered.

As to the proportion of these two bodies to each other, if we consider chlorine as represented by 33.5, and carbon by 5.7, or with Dr. WOLLASTON by 44.1 and 7.5, then the 1.45 of chlorine would be equivalent to 0.2466 of carbon. This is the constitution of the fluid or proto-chloride of carbon; and if we double the 0.2466, the product 0.4932, approaches so near to the experimental result 0.483, that we do not hesitate to regard this compound as consisting of one portion of chlorine and two portions of carbon, or

chlorine - - -	44.1	- - -	33.5
carbon - - -	15	- - -	11.4

It is remarkable, that another of these compounds should be found so soon after the discovery of the two former chlorides of carbon. Its physical properties, and its chemical energies, are in every respect analogous to those of the former compounds; and its constitution increases the probability, that another chloride of carbon may be found, consisting of two portions of chlorine and one of carbon.

All the endeavours we have yet made to form the chloride of carbon now described, or to convert it into either of the other chlorides, have been unsuccessful. We expected that when decomposed by heat, it would produce the protochloride with the liberation of carbon, as the perchloride does with the liberation of chlorine, but we have not yet been able to ascertain that point. We have only to offer as an apology for this and other imperfections in the present paper, the smallness of the quantity of this substance that we possessed.